1.0 Executive Summary

The Columbia River Basin, one of the world's great river basins, is contaminated with many toxic contaminants, some of which are moving through the food web. These toxics in the air, water, and soil threaten the health of people, fish, and wildlife inhabiting the Basin.

In this report, the U.S. Environmental Protection Agency (EPA), Region 10, summarizes what we currently know about four main contaminants in the Basin and the risks they pose to people, fish, and wildlife. We also identify major gaps in current information that we must fill to understand and reduce these contaminants. Current information in the Basin indicates that toxics are a health concern for people, fish, and wildlife, but this information is sparse. In many locations, toxics have not been monitored at all. We do not have enough information in the majority of the Basin to know whether contaminant levels are increasing or decreasing over time. We need to fill these information gaps to understand the impacts on the ecosystem and to plan and prioritize toxics reduction actions.

This report focuses primarily on the following four contaminants: mercury, dichlorodiphenyltrichloroethane (DDT) and its breakdown products, polychlorinated biphenyls (PCBs), and polybrominated diphenyl ether (PBDE) flame retardants. We focus on these contaminants because they are found throughout the Basin at levels that could adversely impact people, fish, and wildlife. Many other contaminants are found in the Basin, including arsenic, dioxins, radionuclides, lead, pesticides, industrial chemicals, and "emerging contaminants" such as pharmaceuticals found in wastewater. This report does not focus on those contaminants, in part because there is a lack of widespread information on their presence in the Basin.

Mercury contaminates the Basin from industrial and energy-related activities occurring within and outside of the Basin. Mercury poses a special challenge because much of the Basin's mercury pollution comes from sources outside of the Basin via atmospheric deposition. At a watershed scale, however, local and regional sources can be significant contributors of mercury to the Basin. Fish consumption advisories for mercury continue to be issued in every state throughout the Basin.

The pesticide DDT and industrial chemicals known as PCBs have been banned since the 1970s, and reduction efforts have lowered their levels in the environment. Unfortunately, these chemicals persist in the environment and continue to pollute the Basin's waterbodies from various sources, including stormwater and agricultural land runoff and hazardous waste releases. In many areas, DDT and PCB concentrations still exceed levels of concern, and fish consumption advisories for these contaminants continue to be issued in every state throughout the Basin.

PBDE flame retardants and other emerging contaminants of concern—such as pharmaceuticals and personal care products—are a growing concern because their levels are increasing in fish and wildlife throughout the Basin. We are just beginning to conduct the research needed to better understand the impacts to the ecosystem from emerging contaminants.

This report provides preliminary information on the presence of mercury, DDT, PCBs, and PBDEs in the following species: juvenile salmon; resident fish (sucker, bass, and mountain whitefish); sturgeon; predatory birds (osprey and bald eagles); aquatic mammals (mink and otter); and sediment-dwelling shellfish (Asian clams). These species can help us understand trends in the levels of toxics in the Basin and judge the effectiveness of toxics reduction efforts.

Some initial steps to address the problem of toxics have already been taken. In 2005, EPA joined other federal, state, tribal, local, and nonprofit partners to form the Columbia River Toxics Reduction Working Group to better coordinate toxics reduction work and share information. The goal of the Working Group is to reduce toxics in the Columbia River Basin and prevent further contamination. This *State of the River Report for Toxics* was identified as a priority by this multi-stakeholder group and was prepared under the leadership of EPA Region 10 with the support and guidance of the Working Group.

Meanwhile, there are many ongoing efforts to reduce toxics in the Basin. Some examples include erosion control efforts in the Yakima Basin; Pesticide Stewardship Partnerships in the Hood River and Walla Walla Basins; PCB cleanup at Bonneville Dam; legacy pesticide collection throughout the Basin;

and investigation and cleanup of the Portland Harbor, Hanford, and Upper Columbia/Lake Roosevelt contamination sites. These and other combined efforts have reduced toxics over the years, but we still need to further reduce toxics to make the Basin a healthier place for people, fish, and wildlife.

To ensure a more coordinated strategy, EPA and our Working Group partners developed a set of six broad Toxics Reduction Initiatives needed to reduce toxics in the Basin. Over the next year, the Working Group will develop a detailed work plan to provide a roadmap for future reduction efforts with input from Basin citizens; local watershed councils; Basin communities and other entities; and tribal, federal, and state governments.

Reducing toxics in the Basin will require a comprehensive, coordinated effort by all levels of government, nongovernmental organizations, and the public. The problems are too large, widespread, and complex to be solved by only one organization. Our hope is that this report and the subsequent toxics reduction work plan will help us make this ecosystem healthier for all who live, work, and play in the Basin.

2.0 Introduction

The Columbia River Basin is one of the world's great river basins in terms of its land area and river volume, as well as its environmental and cultural significance. However, public and scientific concern about the health of the Basin ecosystem is increasing, especially with regard to adverse impacts on the Basin associated with the presence of toxic contaminants. A full understanding of the toxics problem is essential because the health of the Basin's ecosystem is critical to the approximately 8 million people who inhabit the Basin and depend on its resources for their health and livelihood. [1] The health of the ecosystem is also critical to the survival of the hundreds of fish and wildlife species that inhabit the Basin. In this *State of the River Report for Toxics*, we make our first attempt to describe the risks to the Basin's human and animal communities from toxics and to set forth current and future efforts needed to reduce toxics.

The Basin drains about 259,000 square miles across seven U.S. states and British Columbia, Canada. Of that total, about 219,400 square miles, or 85 percent of the Pacific Northwest region, are in the United States; the remaining 39,500 square miles are in Canada. [2] The Basin's rivers and streams carry the fourth largest volume of runoff in North America. The Columbia River begins at Columbia Lake in the Canadian Rockies and travels 1,243 miles over 14 dams to reach the Pacific Ocean a hundred miles downstream from Portland, Oregon. The River's final 300 miles, including the dramatic Columbia River Gorge Scenic Area, form the border between Washington and Oregon. In this report, the Lower Columbia River is considered to be the reach from Bonneville Dam downstream to the Pacific Ocean, the Middle Columbia River is considered to be the reach from Bonneville Dam upstream to Grand Coulee Dam, and the Upper Columbia River is considered to be the reach above Grand Coulee Dam.

Major tributaries to the Columbia River include the Snake, Willamette, Spokane, Deschutes, Yakima, Wenatchee, John Day, Umatilla, Walla Walla, Pend Oreille/Clark Fork, Okanogan, Kettle, Methow, Kootenai, Flathead, Grande Ronde, Lewis, Cowlitz, Salmon, Clearwater, Owyhee, and Klickitat Rivers. The Snake River is the largest tributary to the Columbia River, with a drainage area of 108,500 square miles, or 49 percent of the U.S. portion of the watershed. Another major tributary is the Willamette River, which drains 11,200 square miles and is located entirely within the State of Oregon. [2]

The Basin's salmon and steelhead runs were once the largest runs in the world, with an estimated peak of between 10 million and 16 million fish returning to the Basin annually to about 1 million upriver adult salmon passing Bonneville Dam in recent years. [3] For thousands of years, the tribal people of the Basin have depended on these salmon runs and other native fish for physical, spiritual, and cultural sustenance. Bald eagles, osprey, bears, and many other animals also rely on fish from the Columbia River and its tributaries to survive and feed their young. Historically, the large annual returns of adult salmon and steelhead have contributed important marine nutrients to the ecosystems of the interior Columbia River Basin. The Basin is also economically vital to many Pacific Northwest industries such as sport and commercial fishing, agriculture, transportation, recreation, and tourism. Throughout history, and up to the present day, the Basin has supported settlement and development, agriculture, transportation, and recreation.

There are more than 370 major dams on tributaries of the Columbia River Basin. [4] With its many major federal and nonfederal hydropower dams, the River is one of the most intensive hydroelectric developments in the world. About 65 percent (approximately 33,000 megawatts) of the Pacific Northwest's generating capacity comes from hydroelectric dams. Under normal precipitation, the dams produce about three-quarters (16,200 average megawatts) of the region's electricity. Some of the other major uses of the multi-purpose dams on the Columbia and Snake Rivers include flood control, commercial navigation, irrigation, and recreation. [3]

A National Priority

In 2006, EPA designated the Columbia River Basin as a Critical Large Aquatic Ecosystem in our *2006-2011 Strategic Plan*. [5] The Plan's Goal 4, Healthy Communities and Ecosystems, is "to protect, sustain, or restore the health of people, communities, and ecosystems using integrated and comprehensive approaches and partnerships."

The Columbia River Basin goal states:

> "By 2011, prevent water pollution and improve and protect water quality and ecosystems in the Columbia River Basin to reduce risks to human health and the environment."

The focus of the *2006-2011 Strategic Plan* was achieving more measurable environmental results. Working with state, tribal, and local partners, we selected the following strategic targets for the Columbia River Basin:

- By 2011, protect, enhance, or restore 13,000 acres of wetland habitat and 3,000 acres of upland habitat in the Lower Columbia River watershed.
- By 2011, clean up 150 acres of known highly contaminated sediments in the Lower Columbia River Basin, including Portland Harbor.
- By 2011, demonstrate a 10 percent reduction in mean concentration of contaminants of concern found in water and fish tissue. Contaminants of concern include chlorpyrifos and azinphos methyl in the Little Walla Walla River, DDT in the Walla Walla and Yakima Rivers, and DDT and PCBs in the mainstem.

We selected these targets because historical data were available and each represented measurable outcomes for reduction of toxics in the Basin. Meeting these targets and the overarching goal depends on the states, tribes, local governments, federal government, and nongovernmental agencies working together to improve the health of the Columbia River Basin.

The Story of Contamination in the Columbia River Basin

Fish, wildlife, and people are exposed to many contaminants polluting the water and sediment of the Columbia River Basin. These contaminants come from current and past industrial discharges (point sources) to the air, land, and water and from more widespread sources such as runoff from farms and roads (nonpoint sources) and atmospheric deposition. Some contaminants, such as mercury, also come from natural sources. Even when released in small amounts, some of these contaminants can build up over time to toxic levels in plants and animals.

In 1992, an EPA national survey of contaminants in fish in the United States alerted EPA and others to a potential health threat to tribal and other people who eat fish from the Columbia River Basin. [6] The Columbia River Inter-Tribal Fish Commission (CRITFC) and its four member tribes—the Confederated Tribes of the Warm Springs Reservation of Oregon, the Confederated Tribes and Bands of the Yakama Nation, the Confederated Tribes of the Umatilla Indian Reservation, and Nez Perce Tribe—were concerned for their tribal members who consume fish.

To evaluate the likelihood that tribal people may be exposed to high levels of contaminants in fish, EPA funded the CRITFC tribes to conduct a Columbia River Basin tribal fish consumption survey, which was then followed by an EPA and tribal study of contaminant levels in fish caught at traditional tribal fishing sites. [7,8] The consumption survey showed that the tribal members were

Human activities have contributed many toxic contaminants to the Columbia River Basin over the last 150 years:

- Dioxins, PCBs, metals, and other toxic chemicals were spilled and dumped in Portland Harbor. The sources: boat-building, steel-milling, and sewer discharges.
- "Legacy pollutants"—chemicals banned in the 1970s such as PCBs and chlorinated pesticides such as DDT—still contaminate the river. The sources: farmland, roads, construction sites, and stormwater runoff.
- Newer chemicals, including modern pesticides, flame retardants such as PBDEs, pharmaceuticals, and personal care products, contaminate the river. The sources: runoff and sewers.
- Metals wash into Lake Roosevelt. The sources: metal smelters in Washington and British Columbia.
- Metals wash into the Spokane River. The source: mines in northern Idaho.

eating six to eleven times more fish than EPA's estimated national average at that time of 6.5 grams per day. The fish contaminant study showed the presence of 92 contaminants in fish consumed by CRITFC tribal members and other people in the Columbia River Basin. Some of these contaminant levels were above the levels of concerns for aquatic life or human health. [8] Contaminants measured in Columbia River fish included PCBs, dioxins, furans, arsenic, mercury, and DDE, a toxic breakdown product of the pesticide DDT.

The Origin and Purpose of the Columbia River Toxics Reduction Working Group

Over the past two decades, much information was collected on the levels of contaminants in water, sediment, and fish in the Columbia River Basin. The result was an accumulation of scattered data that needed to be compiled into a Basin-wide report of the potential impacts from contaminants to people, fish, and wildlife. In 2005, EPA joined other federal, state, tribal, local, and non-profit partners to form the Columbia River Toxics Reduction Working Group to better coordinate this work and share information. Our goal is to reduce toxics in the Basin and prevent further contamination. This goal includes reducing toxics in the plants and animals that people eat and ensuring the survival, reproduction, and growth of fish and wildlife in the Basin.

One of the first actions this multi-stakeholder group identified was the development of a report for the Columbia River Basin describing the state of the River. The Working Group recognized toxics as one of several important factors affecting the health of the Basin's people, plants, and animals. We also recognized that toxics had received less attention than other factors and that a report on the influence of toxics was a good first step in understanding the health of the Basin's ecosystem.

This *State of the River Report for Toxics* was prepared under the leadership of EPA Region 10 with the support and guidance of the Working Group. This report sets in motion the process by which we will address the following questions:

- Which toxics are we most concerned about in the Columbia River Basin, and why? Which toxics are the highest priority for cleanup?
- Where are the toxics coming from? How can they be controlled and cleaned up? How can we prevent contamination in the future?
- What can indicator species tell us about the health of the Columbia River Basin? What indicator species should we use to evaluate the health of the ecosystem? Is the health of the ecosystem improving or declining? What additional information do we need to collect so that we can determine changes over time to better understand and deal with the toxics problem?
- What toxics reduction actions are currently under way? Have they been successful? What actions are planned to further reduce toxics?
- What are the next steps to improve the health of the Columbia River Basin ecosystem? What are the short- and long-term monitoring and research needs?

This report will be used to inform people, communities, and decision-makers in the Basin about the toxics problem and to begin a dialogue to identify potential solutions for improving the Basin's health.

VISIT THE WEB In addition to this report, EPA's Columbia River Basin website (http://www.epa.gov/region10/columbia) will provide more detailed and up-to-date information on the health of the Columbia River Basin as work continues.

3.0
Toxic Contaminants

What are Toxic Contaminants?

Toxic contaminants (or toxics) are chemicals introduced to the environment in amounts that can be harmful to fish, wildlife, or people. Some are naturally occurring, but many of these contaminants were manufactured for use in industry, agriculture, or for personal uses such as hygiene and medical care. These synthetic and naturally occurring chemicals can be concentrated to toxic levels and transported to streams through a combination of human activities such as mining or wastewater treatment and through natural processes such as erosion (Figure 3.1).

The fate of a contaminant is determined by its properties—for example, whether the contaminant mixes readily with water or sediment particles, or whether it changes form when exposed to sunlight, bacteria, or heat. A contaminant's location and level of concentration in a river help determine whether fish, wildlife, and people are exposed to it and, if so, whether they experience harmful health effects.

Why are Persistent Toxics a Concern?

Chemicals with well-known effects are generally those chemicals that remain in the environment for a long time (persistent contaminants), contaminate food sources, and increase in concentration in fish and birds. Animals can take in these contaminants directly while foraging for food or drinking water, or they can eat other animals and plants that have absorbed the contaminants. Many contaminants break down slowly, so they accumulate and concentrate in plants, wildlife, and people. The concentration of persistent contaminants through water, sediment, and food sources and within a plant or animal is called *bioaccumulation*. An example of a persistent chemical in the Columbia River is DDT and its breakdown product DDE, both of which are still present in the River nearly 40 years after DDT was banned.

Contaminants in water and sediment are absorbed by microscopic plants and animals, called phytoplankton and zooplankton, as they take in food and water. Many of these chemicals are not easily metabolized, so they persist in living organisms and concentrations build up in their tissues. Plankton, which are

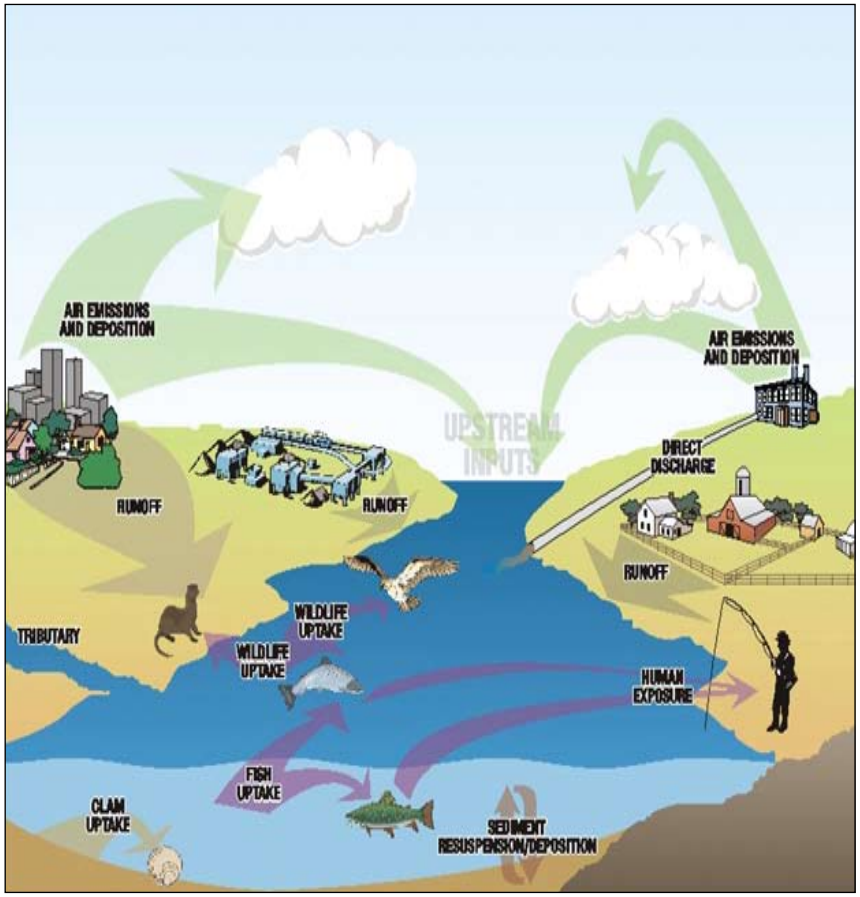

Figure 3.1: Toxic Contaminant Pathways in the Environment

at the bottom of the food web, carry the toxic burden all their lives. As larger animals eat the plankton, the accumulated chemicals are absorbed into each animal's body. Fish and other animals eat the plants, microorganisms, and small fish; the chemical moves into their bodies, and ultimately into larger fish-

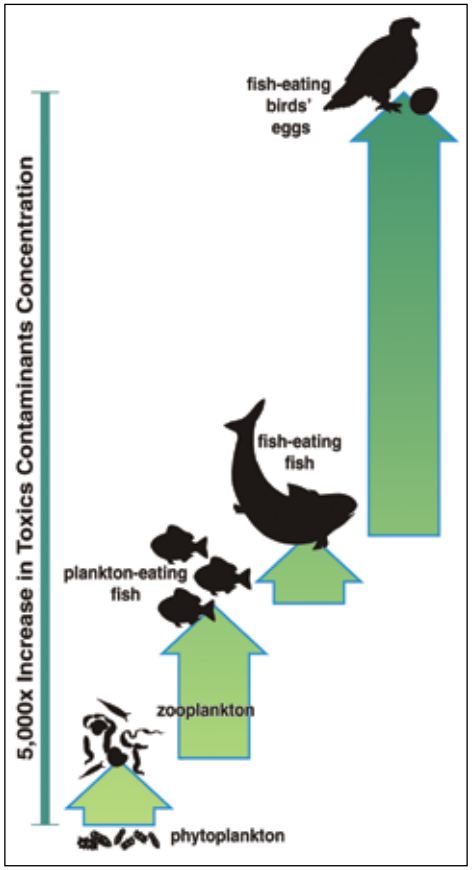

Figure 3.2: Persistent contaminants biomagnify, increasing in concentration up the food web. The highest biomagnification levels can be found in the eggs of fish-eating birds.

eating birds and mammals higher in the food web. This is how contaminant concentrations exponentially increase in fish and fish-eating animals at levels much higher than the concentrations found in the waters the fish live in. Through this *biomagnification* process, top predators, including birds of prey and humans, can accumulate contaminants in higher concentrations than those found in the plants and animals they consume (Figure 3.2). This toxic load builds up in their bodies throughout their lives.

What are the Contaminants of Concern in the Columbia River Basin?

While many contaminants have the potential to be of concern, this report focuses primarily on four contaminants: mercury (including methylmercury); DDT and its breakdown products; PCBs; and PBDEs.

These contaminants are of primary concern because (1) they are widely distributed throughout the Basin; (2) they may have adverse effects on wildlife, fish, and people; (3) they are found at levels of concern in many locations throughout the Basin; and (4) there is an opportunity to build on current efforts to reduce these contaminants within the Basin. [1]

In addition to these four contaminants, many other contaminants of concern were also identified in the Basin. These included metals such as arsenic and lead; radionuclides; several types of pesticides, including current-use pesticides; industrial chemicals; combustion byproducts such as dioxin; and "emerging contaminants" such as pharmaceuticals and personal care products. These contaminants are not the focus of this report, either because there is a lack of widespread information on their presence in the Basin or because they are best suited to more geographically targeted studies within the Basin.

VISIT THE WEB For more information on biomagnification, go to: http://toxics.usgs.gov/definitions/biomagnification.html.

Which Contaminants are Found in People?

Two studies recently investigated the amount and type of toxic contaminants found in people. In 2005, ten Washington residents volunteered to have their hair, blood, and urine tested for the presence of toxics as part of the "Pollution in People" investigative study by the Toxic-Free Legacy Coalition. [2] Each person tested positive for at least 26, and as many as 39, of the 66 toxics tested for, including common pesticides; plasticizers and fragrances found in vinyl, toys, and personal care products; flame retardants found in electronics, mattresses, and furniture; lead, mercury, and arsenic; and both DDT and PCBs.

In 2007, ten Oregon residents representing a diverse group of people from rural and urban areas throughout the state volunteered to have their bodies tested in a study of chemicals in people conducted by the Oregon Environmental Council and the Oregon Collaborative for Health and the Environment. [3] Each person had at least 9, and as many as 16, of the 29 toxics tested for in their bodies. Similar to the Washington study, these toxics included pesticides, mercury, plasticizers, and PCBs. Every participant had mercury, PCBs, and plasticizers in their blood.

While some of these toxics found in people may come from consuming fish or wildlife in the Columbia River Basin, the majority of the toxics found in people come from everyday activities and products such as food, cosmetics, home electronics, plastic products, and furniture. A greater effort to reduce toxics in the products we produce and consume will be needed to limit human exposure and intake of toxics and to reduce the amount of toxics that we put into the ecosystem.

What about Hanford and radionuclides?

For more than 40 years, the U.S. government produced plutonium for nuclear weapons at the Hanford Site along the Columbia River. Production began in 1944 as part of the Manhattan Project, the World War II effort to build an atomic bomb. Plutonium production ended and cleanup began at Hanford in 1989. Over 600 waste sites have been identified in the immediate vicinity of the nuclear reactors. These waste sites have contaminated the groundwater with radionuclides (nuclear waste) and toxic chemicals, above drinking water standards. In certain areas, the contaminated groundwater has reached the Columbia River.

The waste sites and facilities near the River are undergoing an intensive investigation and cleanup effort. One part of that investigation will evaluate the risk to humans and other organisms in the Columbia River ecosystem from Hanford contaminants, including radionuclides, heavy metals, and some organic chemicals. The risk assessment results will be available in 2011. [5] Because of the ongoing investigation and cleanup efforts, this *State of the River Report for Toxics* does not focus on effects on the river from Hanford.

VISIT THE WEB For more information on the "Pollution in People" studies, visit the Toxic-Free Legacy Coalition: http://www.toxicfreelegacy.org/index.html and the Oregon Environmental Council: http://www.oeconline.org/pollutioninpeople.

VISIT THE WEB For more information about the Hanford cleanup, go to: http://yosemite.epa.gov/R10/CLEANUP.NSF/sites/Hanford and www.hanford.gov.

What are Emerging Contaminants of Concern?

A growing number of substances that we use every day, including pharmaceuticals, cosmetics, and personal care products, are turning up in our lakes and rivers, including the Columbia River. [4] These "emerging chemical contaminants" often occur at very low levels. With improved detection technologies, we are becoming more aware of their widespread distribution in the environment, and concerns are increasing about their potential impacts on fish and shellfish, wildlife, and human health. Hormones, antibiotics, and other drugs, which are commonly found in animal and human waste sources, are examples of emerging contaminants. Current-use pesticides and perfluorinated compounds—chemicals used in consumer products to make them stain- and stick-resistant—are other examples of emerging contaminants.

Emerging chemical contaminants include pharmaceuticals and other products that are not properly disposed. These contaminants are increasingly accumulating in waterways, including the Columbia River.

Although several of these emerging contaminants have been detected in water and sediment in the Lower Columbia River, information from locations elsewhere in the Basin is extremely limited. In response to these newly recognized contaminants, the U.S. Geological Survey (USGS) is sponsoring a four-year study in the Lower Columbia River addressing the movement of emerging contaminants from water to sediment, and through the food web to fish-eating birds, to evaluate the threat to the environment and human health.

Dioxins: A success story in toxics reductions

A 1987 EPA study showed unsafe levels of dioxin in fish from the Columbia River [6] Dioxins are persistent bioaccumulative toxins that can cause developmental and reproductive problems and potentially increase the risk of cancer. Dioxins are a byproduct of combustion and manufacturing processes, including bleaching paper pulp with chlorine.

In response to the study, in 1991 EPA collaborated with Oregon and Washington to require reductions in the amount of dioxin discharged by 13 paper mills to the Columbia, Snake, and Willamette Rivers. These pulp and paper mills subsequently changed their bleaching process, which reduced releases of dioxins into the Columbia River Basin.

Since 1991, dioxin concentrations in resident fish in the Columbia have decreased dramatically (Figure 3.3). [7,8,9,10,11,12] The dioxin content of osprey eggs has also shown a significant reduction in the lower part of the river. [13] However, dioxin is extremely persistent, and fish consumption advisories are still in place for some locations in the Basin.

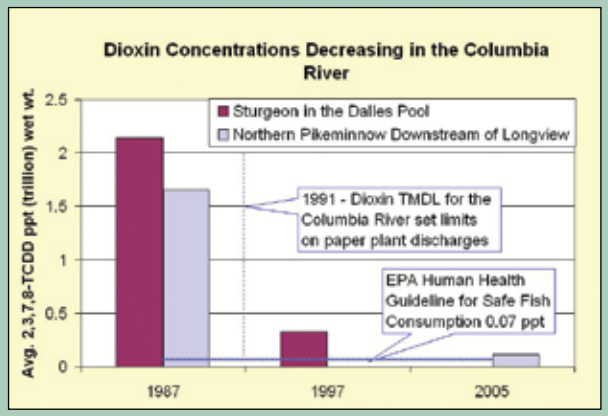

Figure 3.3: Dioxin levels in Columbia River fish have decreased significantly since pulp and paper mills changed their bleaching process, which reduced dioxin discharges in the early 1990s.

VISIT THE WEB For more information about dioxins in the Columbia River Basin, go to: www.deq.state.or.us/wq/TMDLs/columbia.htm and www.ecy.wa.gov/biblio/97342.html.

Fish Consumption Advisories for Toxics are Widespread across the Basin

When a river or lake becomes contaminated, it is not only an ecological loss but also a significant resource loss for people who depend on those fish for their diet. Fish consumption advisories are issued for lakes and rivers where various levels of fish consumption are no longer safe due to toxics in fish.

State health departments have issued public fish consumption advisories about the types and amounts of fish that are safe to eat from specific waters, including waters of the Columbia River Basin (Figure 3.4). In Washington, Oregon, Idaho, and Montana, people are advised to limit meals of fish such as bass, trout, walleye, and bottom fish from certain streams and lakes due to concerns about high levels of mercury, PCBs, and other contaminants. Because testing has shown high mercury concentrations in certain species, and because there is a lack of data from many water bodies, Washington has issued a statewide mercury advisory for consumption of bass and Idaho has issued a statewide mercury advisory for bass and walleye.

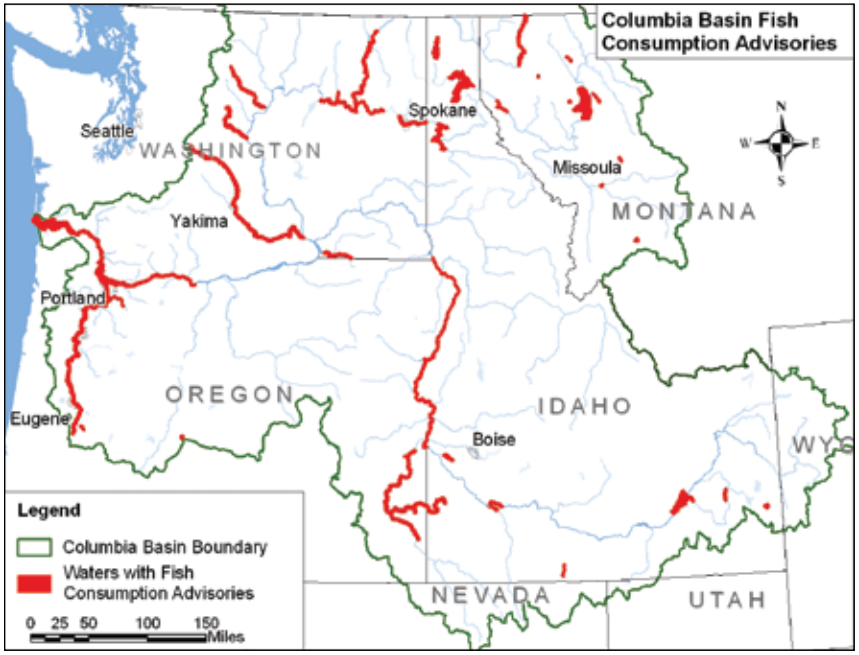

Figure 3.4: State-issued fish consumption advisories are in effect throughout the Columbia River Basin for certain contaminants and species. Not all waters have been tested, so the absence of an advisory does not necessarily mean it is safe to consume unlimited quantities of fish from untested waters.

VISIT THE WEB

Find information about fish consumption advisories for Washington: http://www.doh.wa.gov/ehp/oehas/fish/
Oregon: www.oregon.gov/DHS/ph/envtox/fishconsumption.html
Idaho: www.Idahohealth.org and Montana: www.dphhs.mt.gov/fish2005.pdf.